



Chapter Project

Growing a Crystal Garden

The following steps will walk you through the Chapter Project. Use the hints and detailed directions as you guide your students through the creation of their crystal gardens, data collection, presentation, and reflection.

Chapter Project Overview

In this project, students will work either individually or in small groups to design and create a crystal garden and then observe and compare growth of several types of crystals. Each garden should include an attractive garden scene using common materials as well as at least two kinds of crystals.

To introduce the project, focus students' attention on pictures of mineral crystals, either in their text or in books about minerals. Explain that in this project they will be growing similar crystals from chemicals in solutions. Then show students pictures of garden scenes, such as famous English or Japanese gardens. Point out how the shapes and colors create an attractive whole.

Distribute the Chapter Project Overview. Review the project's rules. You may also want to hand out the Chapter Project Scoring Rubric so students will understand what is expected of them.

If appropriate, organize the class into pairs or small groups. The advantages of using groups include fewer materials needed and more collaboration among students of differing abilities. The advantage of individual gardens is that each student will gain more experience with growing crystals.

Set a deadline for the project presentation and some interim dates at the end of Sections 1 and 2. Have students copy the dates in their Project Time Line.

Distribute Chapter Project Worksheet 1. After students have read the worksheet, ask if they have any questions.

Materials and Preparation

Perhaps the best container for a crystal garden is a clear plastic shoe box. Gather enough of these for each student or group, or ask that students find their own containers. Any large, clear container could be appropriate.

The objects used for crystal substrates can be practically anything, though materials that are porous work best to hold the solutions and crystals. Good objects include charcoal, plastic foam, sponges, and cotton swabs. Many such materials can be made into shapes that will make attractive or representational scenes.

With Worksheet 2, students will create a salt solution to begin making crystals. Point out that they can do the procedure more than once, each time adding a different color of food coloring. In that way they can create a more attractive garden, though the salt crystals will always be the same shape.

Prepare ahead of time several other solutions for students' use. Various chemicals that you can purchase at a pharmacy or grocery store can be used. These include sugar (sucrose), Epsom salts, alum (aluminum potassium sulfate), and magnesium sulfate. Each chemical will produce a different crystal shape, from cubes to long, thin needles.

To prepare an alum or Epsom salts solution, follow this procedure. The resulting solution will be enough for five or six groups, depending on the size of their garden containers.

1. Heat 600 mL of water. Do not bring to boil.
2. Add 120 g of alum or 70 g of Epsom salts to warm water. Stir occasionally until the chemical has dissolved.
3. Pour the solution into a 1-L jar and seal it with a lid. Allow to cool over 24 hours. Then add a pinch of alum or Epsom salts to initiate precipitation. Shake twice a day. Add different colors of food coloring to different batches of solution.
4. When groups' gardens are ready, pour the solution (minus any precipitate) into a new jar and warm it again. Add an additional 24 g of alum or 10 g of Epsom salts to make sure the solution is saturated.

Prepare additional solutions with other chemicals in a similar way. Remember, the goal is to make saturated solutions that will readily grow crystals. Water temperature is the key to creating such a solution. Warmer water will dissolve more solute; as the solution cools, precipitation will occur.

Keep Students on Track— Section 1

As you review each student's materials list and sketches from Worksheet 1, encourage those who lack ideas to talk to classmates to gather more ideas.

Distribute Chapter Project Worksheet 2. Then provide each student or group with the materials needed to prepare the salt solution. An alternative to using the hot plate is to have students use hot tap water.

Demonstrate how to use the plastic dropper to add solution to an object in a garden scene.

Emphasize that students need to make an accurate map of their gardens and the places where each solution has been added. Without a map, students will forget what kind of crystal is growing where.

Provide different kinds of solutions for students to add to their scenes. Make sure each plastic dropper is used for only one kind of solution.

Keep Students on Track— Section 2

As you check the gardens, make sure students are having some success in growing crystals. Help any who are having trouble.

Make sure students are keeping a daily record of crystal growth, complete with sketches of the different kinds of crystals.

Discuss how students could compare the growth of different kinds of crystals. This might be a line or bar graph or a detailed paragraph.

Chapter Project Wrap Up

Examine each student's or group's crystal garden before their presentation. Have students "walk you through" what they will say, and make suggestions about logical sequence or any missing information in their report. If this is a group project, make sure all group members plan to participate.

Provide class time for the presentations. Allow each student or group to present the garden, with an emphasis on the materials used and the crystals grown. Encourage other students to ask questions.

After all presentations have been made, discuss with students which crystal gardens were best, both in design and results.

Encourage students to evaluate how well they created the garden they planned to create, how attractive their garden scenes were, and how well their crystals grew. Stress that they should identify in their journals ways in which they could have made their gardens better.

Extension

Have interested students draw from scenes of a variety of students or groups to make a large crystal garden in an aquarium. Then find a place in the school to display their creation.

**Chapter Project****Growing a Crystal Garden**

If you've ever seen a well-made garden, you've seen a work of art. A good gardener doesn't just plant flowers and bushes in any old place. Instead, each plant is considered for its color and shape as the gardener strives to make a pleasing whole impression. In this project, you have a chance to design and create a garden, but with crystals rather than plants.

First, you'll build a three-dimensional garden scene, using materials supplied by your teacher as well as materials you bring from home. This garden scene can be either a model of some landscape you've seen or an artistic creation of your own. Next, you'll prepare and add solutions to the objects in your garden scene, recording on a detailed map where each solution was added. From these solutions crystals will grow. You'll keep track of the growth of each kind of crystal, making sketches and recording growth data. At the end of the project, you'll present your crystal garden to the class.

Project Rules

- Complete Worksheet 1 by making a list of materials you could use to create a three-dimensional garden scene and by making a sketch of a possible garden.
- Collect the materials you will use to create your garden.
- Create a garden scene. This could be either a representation of a real landscape or an artistic creation using shapes and colors to make a pleasing effect.
- Follow Worksheet 2 to make a salt solution, and add it to your garden scene. Then add other solutions supplied by your teacher.
- Make a detailed map of your garden that includes exactly where you "planted" each kind of crystal. If your map is not accurate or doesn't include enough labels, your observations of crystal growth will be flawed.
- As your crystals grow, make sketches that accurately show the shape of each kind. At first, your sketches might be rough. Toward the end of the project, make a good sketch of each kind of crystal you've grown.
- Take and record measurements of each kind of crystal. You can do this with a metric ruler or some other measuring device. Record your measurements in a data table or a daily journal. You'll want to record when crystals begin growing, how much they grow each day, and when they stop growing.
- Make a comparison of the growth of the different crystals. You could do this in writing or with some kind of graph, depending on the data you've kept.

- Prepare a presentation to the class of your crystal garden. As part of this presentation, you will describe the materials you used to build your garden and the types of crystals grown. You will also show sketches of your crystals and present a comparison of the growth of each kind of crystal.

Project Hints

As soon as possible, begin collecting the materials you will use to create your garden. These include a container and various objects on which your crystals will grow. Your teacher may be able to provide some materials, but you will probably want to bring some materials from home.

Be as creative as you can in planning and building your garden scene. Remember, if your materials are unique to your garden, your garden will be different from all others in the class.

You can make your garden scene like a realistic landscape, with mountains, rivers, forests, and so on. Or you could make an attractive scene just by using artistic shapes and colors, like a modern painting.

Talk with your teacher and other class members about ways to take measurements of crystal growth and ways to compare those measurements.

As you prepare for your presentation, think of what you want to say and the order in which you want to present the information. You may want to make notes on index cards to help you remember what you want to say.

Project Time Line

Task

Due Date

1. Complete Worksheet 1
2. Gather materials needed for garden scene
3. Create three-dimensional garden scene
4. Review plans with your teacher
5. Prepare solution with Worksheet 2
6. Add solutions to garden, recording on map
7. Prepare comparison of crystal growth rates
8. Make sketches of crystals grown
9. Present your crystal garden to class

Creating a Crystal Garden

To get started on creating a crystal garden, you need to think about the materials you will use and the garden scene you will make.

Materials

What materials can you use to make an attractive garden scene? Make a list below of possibilities of objects on which you could grow crystals. Porous materials, such as charcoal, plastic foam, and sponges will work best.

1. Possible container:

2. Possible materials:

Garden Scene

What will your garden scene look like when completed? Make a sketch in the space below of an attractive garden scene that you would like to create.

If you're working in a group, take this design to a group meeting and present your ideas to the other members for consideration. If you're creating your garden alone, show this design to other classmates and ask for advice and criticism. Then show it to your teacher.

Getting Started With Salt Crystals

Your crystal garden must contain at least two different kinds of crystals, though it may contain more. Your teacher will provide solutions to grow some kinds of crystals. The procedure here will give you a chance to prepare your own salt solution from which you can grow salt crystals.

Materials

hot plate
pan
salt
tablespoon
food coloring
water
clean jar with lid
plastic dropper

Procedure     Review the safety guidelines in Appendix A.

1. Cover the bottom of the pan with water, and heat the water almost to boiling on the hot plate.
2. Pour salt into the hot water, stirring as you pour. Add salt until no more salt dissolves into the water.
3. Allow the salt solution to cool slightly, and then pour it into the jar and screw on the lid. Allow the water to cool for 24 hours.
4. Remove with a spoon any salt crystals that have formed overnight. Or, you can shake the jar twice a day until no more salt crystals form.
5. Pour the solution back into the pan and reheat on the hot plate. When the water is hot but not boiling, add a tablespoon of salt to the solution and stir.
6. Use a plastic dropper to add food coloring, and stir the solution.
7. Use a plastic dropper to cover objects in your garden scene with the salt solution. Add enough solution to saturate the objects, but do not add so much that you create standing puddles. Remember that you will want to cover some objects with other kinds of solutions.
8. Observe the growth of crystals within two to four days.

Minerals ▪ *Chapter Project*

Scoring Rubric



Chapter Project

Growing a Crystal Garden

In evaluating how well you complete the Chapter Project, your teacher will judge your work in the following categories. In each, a score of 4 is the best rating.

	4	3	2	1
Creating a Crystal Garden Scene	Garden scene is creatively designed and attractive and contains well-formed examples of at least four kinds of crystals.	Garden scene is carefully designed and attractive and contains well-formed examples of at least three kinds of crystals.	Garden scene is partially designed and fairly attractive and contains examples of at least two kinds of crystals.	Garden scene does not appear to be well planned and contains examples of only one or two kinds of crystals.
Recording Crystal Growth	Makes well-drawn sketches of each kind of crystal as well as accurate measurements and comparisons of crystal growth.	Makes sketches of each kind of crystal as well as measurements and comparisons of most crystal growth.	Makes sketches of each kind of crystal as well as some measurements and comparisons of crystal growth.	Makes sketches of some crystals; measurements and comparisons of crystal growth are incomplete.
Presenting the Crystal Garden	Makes a thorough and interesting presentation that includes a good explanation of materials used and a logical comparison of crystals grown.	Makes an adequate presentation of the system that includes a clear explanation of materials used and a comparison of crystals grown.	Makes a presentation of the system that includes a partial explanation of materials used and some comparison of crystals grown.	Makes a presentation of the system that includes a weak explanation of materials used and an incomplete comparison of crystals grown.
Participating in the Group (optional)	Takes a lead in planning, creating, and presenting the crystal garden.	Participates in all aspects of planning, creating, and presenting the crystal garden.	Participates in most aspects of planning, creating, and presenting the crystal garden.	Participates minimally in planning, creating, and presenting the crystal garden.